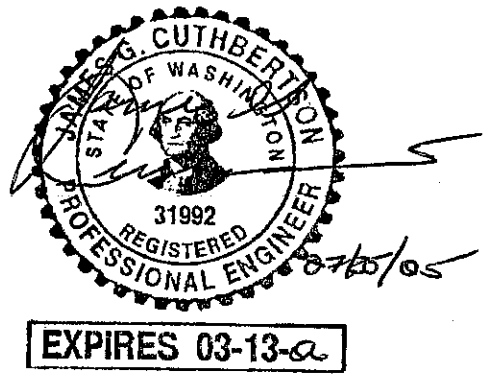
Washington State Department of Transportation

Memorandum

July 26, 2005



TO: G. Wagemann / M. Pea
Eastern Region Design Office

FROM: T. Allen / M.A. Frye
EEP Geotechnical Division MS: 47365
Fax (360) 709-5585

SUBJECT: SR 270, OL-3502
Pullman to Idaho State Line
Signal Pole Foundation Recommendations

Introduction

This memorandum presents foundation recommendations for three signal poles and four advance warning system poles associated with the subject project. The signals and advance warning systems will be located at the intersections of Airport Road with SR 270. An existing signal system at the western intersection will be supplemented with an advance warning system (Signal Standards 8 and 9). A new signal system and advance warning system will be constructed at the eastern intersection (Signal Standards 1, 3, 4, 10, and 11). The following table presents the signal standard numbers, station, and offset of each of the proposed poles.

Signal Standard Number	SR 270 Station	Offset
8	103+29	46' Rt.
9	113+24	56' Lt.
10	354+54	52' Rt.
4	348+80	44' Rt.
1	348+80	59.5' Lt.
3	349+93.5	44' Rt.
11	353+23	56' Lt.

We understand recommendations for other signal poles associated with the project will be provided by the Eastern Region Materials Laboratory.

The analysis, conclusions, and recommendations provided in this memorandum are based on our understanding of the project and site conditions existing at the time of our site review and field exploration program. The exploratory borings are assumed to be representative of the subsurface conditions at locations throughout the site. If during construction, subsurface conditions differ from those described in the explorations, we should be advised immediately so that we may reevaluate our recommendations and provide assistance.

Project Description

This project involves widening of the existing two-lane highway between Pullman and the Idaho State Line. As part of this project, two intersections between SR 270 and Airport Road will be reconfigured and receive new signals and advance warning systems. A complete project description, regional geology discussion, vicinity map, and plan sheets are available in the April 2005 Geotechnical Report titled *Pullman to Idaho State Line*, by James R. Struthers and Tom C. Badger.

Field Exploration

Our field exploration consisted of advancing one boring at 6 of the proposed signal locations. Subsequent to our field investigation, Standard number 1 was moved to an offset of 59.5 feet left of centerline. This is approximately 12.5 feet from the location of the boring. The location of each of the borings, and the associated Standard are provided in the following table.

Boring Number	SR 270 Station	Offset	Associated Signal Standard Number	Bedrock Elevation (ft)
SH-1-05	103+29	46' Rt.	8	2396.18
SH-2-05	354+54	52' Rt.	10	2503.18
SH-3-05	348+80	47' Lt.	4	2503.72
SH-4-05	348+80	44 Rt.	1	2509.40
SH-5-05	349+93.5	44' Rt.	3	2507.55
SH-6-05	353+23	56' Lt.	11	2507.43

Borings H-2-03 and H-3-03, conducted as part of the investigation for the above mentioned geotechnical report, provided sufficient information for the foundation design for Standard number 9.

Subsurface Conditions

In general, three distinct soil units were encountered in the vicinity of the proposed signal standard foundations. Wind-blown loess, consisting of very soft to medium stiff silty clay was generally found at the surface to depths varying between 10 to 15 feet. Underlying the loess, a 1- to 5-foot thick layer of silty sand or silty gravel was encountered. Basalt bedrock was encountered below the silty sands and gravels.

The silty sands and gravels were generally recorded as wet at the time of the field explorations. We anticipate groundwater will be encountered in these soils.

Geotechnical Recommendations

Signal Standards 8, 10, 4, and 3

We recommend an allowable lateral bearing capacity of 800 psf be used for the design of the foundations for Signal Standards 8, 10, 4, and 3. We recommend the structural designer attempt to use short, large diameter shafts in order to eliminate the need for shaft excavation into the bedrock. Bedrock elevations are provided in the table above. If it is necessary to extend the foundation shafts into the bedrock, we recommend an allowable lateral bearing capacity of 5000 psf be used for the portion of the shaft in the rock. We recommend rock sockets be less than 4 feet in diameter as larger diameter shafts will be difficult to excavate in the rock.

Signal Standards 1 and 11

Signal Standards 1 and 11 will be constructed in proposed embankment fill. We recommend an allowable bearing capacity of 1000 psf be used for the design of these foundations. We recommend the structural designer attempt to use short, large diameter shafts in order to eliminate the need for shaft excavation into the bedrock. Bedrock elevations are provided in the table above. If it is necessary to extend the foundation shafts into the bedrock, we recommend an allowable lateral bearing capacity of 5000 psf be used for the portion of the shaft in the rock. We recommend rock sockets be less than 4 feet in diameter as larger diameter shafts will be difficult to excavate in the rock.

Signal Standard 9

Signal Standard 9 will be located in a proposed rock cut. Basalt bedrock will be at the surface at the location of the signal foundation. Standard Plan signal foundations are suitable at this location. However, some cost savings may be realized by using a special design signal foundation. We recommend an allowable lateral bearing capacity of 5000 psf be used for this location.

As an alternative, spread footings are also suitable at this location. Spread footings may limit the amount of rock excavation necessary. We recommend an allowable bearing

capacity of 10 tons per square foot be used. If the footing is designed using Load Factor Design, we recommend using a minimum bearing capacity safety factor of 2.3. If the footing is designed using Allowable Stress Design, we recommend a minimum bearing capacity safety factor of 3.0 be used. If design of a spread footing results in a footing size that is prohibitively large, rock bolts may be used to tie down a small spread footing. We can provide design parameters for rock bolts if this alternative is chosen.

Construction Considerations

Groundwater should be anticipated in the silty sands and gravels overlying the basalt bedrock. The Contractor should be prepared to advance the shaft foundations in wet conditions. Temporary casing will likely be necessary due to the soft nature of the overlying loess soils and the potential for running sands in the soils directly overlying the bedrock. The Contractor should be prepared to excavate into the basalt bedrock.

If you have questions or require further information, please contact Mark Frye at (360) 709-5469 or Tony Allen at (360) 709-5450.

Designed By: Mark A. Frye
Project Geotechnical Engineer

Reviewed By: Jim Cuthbertson
Chief Foundation Engineer

TMA/maf
Attachments: Boring Logs

cc: Gary Bedi, Bridge and Structures, MS47340
Gion Gibson, Eastern Region Materials Engineer

Washington State Department of Transportation

LOG OF TEST BORING

Start Card S-22749

HOLE No. SH-1-05

Sheet 1 of 1

Job No. OL-3502 SR 270 Elevation 2408.2 ft (734.0 m)

Project Pullman to Moscow (Structures)

Driller Vince Johnson Lic# 2532

Site Address Vic SR 270 & Airport Rd. West

Inspector Bill Hanning

Start June 22, 2005 Completion June 22, 2005 Well ID#

Equipment CME 850 w/ autohammer

Station 103+29 Offset Casing 3.5"

Method Wet Rotary

Northing 852344.71 Easting 2809821.44 Latitude Longitude

County Whitman Subsection SE/SE Section 31 Range 46 EWM Township 15 N

Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft (10 20 30 40)	SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
5	1			1 0 1 (1)		D-1		SILT with sand, and some gravel, very loose, very dark grayish brown, wet, Homogeneous, no HCl reaction Length Recovered 0.5 ft, Length Retained 0.5 ft		
10	2 3			17 20 19 (39)		D-2		Poorly graded GRAVEL with sand, with trace silt, subangular, dense, dark grayish brown, moist, Homogeneous, no HCl reaction, Note contact with gravel at 8.0ft Length Recovered 0.3 ft, Length Retained 0.3 ft		
15	4 5			50/2" (50) RQD 0 FF 20		D-3 C-4		No Recovery Basalt, dark gray, fine grained, highly weathered, moderately strong rock, no HCl reaction. Discontinuities are very closely spaced and in poor condition, Note rock contact at 12.0ft., Percent Recovered 100.0%		
20	6							End of test hole boring at 19 ft below ground elevation. This is a summary Log of Test Boring. Soil/Rock descriptions are derived from visual field identifications and laboratory test data.		
25	7									

SOIL OL-3502 PULLAM TO MOSCOW(STRUCTURE).GPJ SOIL.GDT 7/14/05,11:54:58

Washington State Department of Transportation

LOG OF TEST BORING

Start Card S-22748

HOLE No. SH-2-05

Sheet 1 of 1

Job No. OL-3502 SR 270 Elevation 2519.4 ft (767.9 m)

Project Pullman to Moscow (Structures) Driller Vince Johnson Lic# 2532

Site Address Vic. SR 270 & Airport Rd. East Inspector Bill Hanning

Start June 22, 2005 Completion June 22, 2005 Well ID# Equipment CME 850 w/ autohammer

Station 345+54 Offset 52ft RT Casing 3.5" Method Wet Rotary

Northing 859549.74 Easting 2832321.77 Latitude Longitude

County Whitman Subsection SE/SE Section 31 Range 46 EWM Township 15 N

Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft (10 20 30 40)	SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
5	1			1 1 2 (3)		D-1		Lean CLAY, with some sand and trace organics, soft, black, moist, Homogeneous, no HCl reaction, Note 100 % drill fluid loss at 2.0ft Length Recovered 1.2 ft, Length Retained 1.2 ft		
10	2 3			1 2 2 (4)		D-2		Lean CLAY, with some sand and organics, soft, dark greenish gray, moist, Homogeneous, no HCl reaction Length Recovered 1.0 ft, Length Retained 1.0 ft		
15	4 5			13 16 18 (34)		D-3		Silty SAND, with some fine gravel, dense, dark greenish gray, moist, Stratified, no HCl reaction, Note soil change at 13.5ft. Length Recovered 1.2 ft, Length Retained 1.2 ft		
20	6		>>	70/6" (70)		D-4		Poorly graded GRAVEL, angular, very dense, very dark gray, moist, Homogeneous, no HCl reaction, Highly weatherd bedrock contact at 16.2ft Length Recovered 0.5 ft, Length Retained 0.5 ft End of test hole boring at 18.5 ft below ground elevation.		
25	7							This is a summary Log of Test Boring. Soil/Rock descriptions are derived from visual field identifications and laboratory test data.		

SOIL OL-3502 PULLAM TO MOSCOW(STRUCTURE).GPJ SOIL.GDT 7/14/05,11:54:59

Washington State Department of Transportation

LOG OF TEST BORING

Start Card S-22748

HOLE No. SH-3-05

Job No. OL-3502 SR 270 Elevation 2519.7 ft (768.0 m)

Sheet 1 of 1

Project Pullman to Moscow (Structures) Driller Vince Johnson Lic# 2532

Site Address Vic. SR 270 & Airport Rd. East Inspector Bill Hanning

Start June 22, 2005 Completion June 22, 2005 Well ID# Equipment CME 850 w/ autohammer

Station 348+80 Offset 47ft Lt Casing 3.5" Method Wet Rotary

Northing 859512.11 Easting 2832658.2 Latitude Longitude

County Whitman Subsection SE/SE Section 31 Range 46 EWM Township 15 N

Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft (10 20 30 40)	SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
5	1			1 1 1 (2)		D-1		Silty GRAVEL with sand, angular, very loose, very dark grayish brown, wet, Homogeneous, no HCl reaction Length Recovered 0.8 ft, Length Retained 0.8 ft		
10	2 3			2 3 3 (6)		D-2		Lean CLAY, with organics & some fine sand, medium stiff, dark greenish gray, moist, Homogeneous, no HCl reaction Length Recovered 1.3 ft, Length Retained 1.3 ft		
15	4 5			4 3 14 (17)		D-3		Silty SAND with gravel, and some sandy silt stratification, medium dense, olive yellow, wet, Stratified, no HCl reaction, Note drilling indicates gravel at 12.0 ft. Length Recovered 1.5 ft, Length Retained 1.5 ft		
				50/3" (50)		D-4		No Recovery		
20	6							End of test hole boring at 18.8 ft below ground elevation. This is a summary Log of Test Boring. Soil/Rock descriptions are derived from visual field identifications and laboratory test data.		
25	7									

SOIL OL-3502 PULLAM TO MOSCOW(STRUCTURE).GPJ SOIL.GDT 7/14/05,11:54:59

Washington State Department of Transportation

LOG OF TEST BORING

Start Card S-22748

HOLE No. SH-4-05

Sheet 1 of 1

Job No. OL-3502 SR 270 Elevation 2522.9 ft (769.0 m)

Project Pullman to Moscow (Structures) Driller Vince Johnson Lic# 2532

Site Address Vic. SR 270 & Airport Rd. East Inspector Bill Hanning

Start June 21, 2005 Completion June 21, 2005 Well ID# Equipment CME 850 w/ autohammer

Station 348+80 Offset 44 ft Rt. Casing 3.5" Method Wet Rotary

Northing 859433.85 Easting 2832612.2 Latitude Longitude

County Whitman Subsection SW/SW Section 32 Range 46 EWM Township 15 N

Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft (10 20 30 40)	SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
5	1			1 2 2 (4)		D-1		SILT, with organics and trace sand, very loose, black, moist, Homogeneous, no HCl reaction Length Recovered 1.0 ft, Length Retained 1.0 ft		
10	2 3			1 2 3 (5)		D-2		SILT, with organics and some sand, loose, greenish gray, moist, Stratified, no HCl reaction, Note bottom 0.2ft of sample to be coarse sand with some fine gravel. Length Recovered 1.0 ft, Length Retained 1.0 ft		
15	4 5		>>	70/6" (70)		D-3		Silty GRAVEL, angular, very dense, black, moist, Homogeneous, no HCl reaction, Fractured basalt, note contact at 13.5 ft. Length Recovered 0.5 ft, Length Retained 0.5 ft End of test hole boring at 15 ft below ground elevation.		
20	6							This is a summary Log of Test Boring. Soil/Rock descriptions are derived from visual field identifications and laboratory test data.		
25	7									

SOIL OL-3502 PULLAM TO MOSCOW(STRUCTURE).GPJ SOIL.GDT 7/14/05,11:54:59

Washington State Department of Transportation

LOG OF TEST BORING

Start Card S-22749

HOLE No. SH-5-05

Sheet 1 of 1

Job No. OL-3502 SR 270 Elevation 2523.6 ft (769.2 m)

Project Pullman to Moscow (Structures) Driller Vince Johnson Lic# 2532

Site Address Vic. SR 270 & Airport Rd. East. Inspector Bill Hanning

Start June 22, 2005 Completion June 22, 2005 Well ID# Equipment CME 850 w/ autohammer

Station 349+93.5 Offset 44 ft. Rt. Casing 3.5" Method Wet Rotary

Northing 859373.79 Easting 2833017.52 Latitude Longitude

County Whitman Subsection SW/SW Section 32 Range 46 EWM Township 15 N

Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft (10 20 30 40)	SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
5	1			1 2 2 (4)		D-1		Lean CLAY, with organics and trace sand, soft, black, moist, Homogeneous, no HCl reaction Length Recovered 1.2 ft, Length Retained 1.2 ft		
10	3			1 2 3 (5)		D-2		Lean CLAY, with some organics, medium stiff, black, moist, Homogeneous, no HCl reaction Length Recovered 1.2 ft, Length Retained 1.2 ft		
15	5			2 5 5 (10)		D-3		Silty SAND, with some gravel, loose, dark greenish gray, wet, Homogeneous, no HCl reaction Length Recovered 0.8 ft, Length Retained 0.8 ft		
20	6			60/1" (60)		D-4		Poorly graded GRAVEL, angular, very dense, black, moist, Homogeneous, no HCl reaction, Fractured Basalt, contact at 16.0ft Length Recovered 0.1 ft, Length Retained 0.1 ft End of test hole boring at 18.1 ft below ground elevation.		
25	7							This is a summary Log of Test Boring. Soil/Rock descriptions are derived from visual field identifications and laboratory test data.		

SOIL OL-3502 PULLAM TO MOSCOW(STRUCTURE).GPJ SOIL.GDT 7/14/05,11:55:00

Washington State Department of Transportation

LOG OF TEST BORING

Start Card S-22850

HOLE No. SH-6-05

Sheet 1 of 1

Job No. OL-3502 SR 270 Elevation 2519.4 ft (767.9 m)

Project Pullman to Moscow (Structures) Driller Vince Johnson Lic# 2532

Site Address Vic. SR 270 & Airport Rd. East Inspector Bill Hanning

Start June 21, 2005 Completion June 21, 2005 Well ID# Equipment CME 850 w/ autohammer

Station 353+23 Offset 56 ft. Lt. Casing 3.5" Method Wet Rotary

Northing 859238.28 Easting 2833017.52 Latitude Longitude

County Whitman Subsection SW/SE Section 4 Range 45 EWM Township 14 N

Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft (10 20 30 40)	SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
5	1			1 1 2 (3)		D-1		SILT, with some sand and organics, very loose, dark greenish gray, moist, Homogeneous, HCl reaction not tested Length Recovered 1.0 ft, Length Retained 1.0 ft		
10	3			4 18 28 (46)		D-2		Well graded SAND with gravel, and trace silt, dense, yellowish olive, wet, Homogeneous, no HCl reaction, Note contact with gravel at 8.5 ft. Length Recovered 0.5 ft, Length Retained 0.5 ft		
	4		>>	70/4" (70)		D-3		No Recovery		
15	5							End of test hole boring at 14.3 ft below ground elevation.		
20	6							This is a summary Log of Test Boring. Soil/Rock descriptions are derived from visual field identifications and laboratory test data.		
25	7									

SOIL OL-3502 PULLAM TO MOSCOW(STRUCTURE).GPJ SOIL.GDT 7/14/05,11:55:00